## WHAT IS CLAIMED IS:

- 1. A radio frequency (RF) down-convertor with reduced local oscillator leakage, for demodulating an input signal x(t), comprising:
- a synthesizer for generating time-varying mixing signals  $\phi_1$  and  $\phi_2$  which vary irregularly over time, where  $\phi_1$  \*  $\phi_2$  has significant power at the frequency of a local oscillator signal being emulated, and neither  $\phi_1$  nor  $\phi_2$  has significant power at the frequency of said local oscillator signal being emulated;
- a first mixer coupled to said synthesizer for mixing said input signal x(t) with said time-varying mixing signal  $\varphi_1$  to generate an output signal x(t)  $\varphi_1$ ; and
- a second mixer coupled to said synthesizer and to the output of said first mixer for mixing said signal x(t)  $\varphi_1$  with said time-varying mixing signal  $\varphi_2$  to generate an output signal x(t)  $\varphi_1$   $\varphi_2$ .
- 2. The radio frequency (RF) down-convertor of claim 1 wherein said synthesizer further comprises:
- a synthesizer for generating time-varying mixing signals  $\varphi_1$  and  $\varphi_2$ , where  $\varphi_1 * \varphi_1 * \varphi_2$  does not have a significant amount of power within the bandwidth of said input signal x(t) at baseband.
- 3. The radio frequency (RF) down-convertor of claim 2, further comprising: a DC offset correction circuit.
- 4. The radio frequency (RF) down-convertor of claim 3, wherein said DC offset correction circuit comprises:
- a DC source having a DC output; and a summer for adding said DC output to an output of one of said mixers.
- 5. The radio frequency (RF) down-convertor of claim 2, further comprising: a closed loop error correction circuit.
- 6. The radio frequency (RF) down-convertor of claim 5, wherein said closed loop error correction circuit further comprises:

an error level measurement circuit and

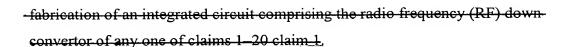
a time-varying signal modification circuit for modifying a parameter of one of said  $\frac{\text{time-varying}}{\text{mixing}} \text{ signals } \underline{\phi_1} \text{ and } \underline{\phi_2} \text{ to minimize said error level.}$ 

- 7. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a power measurement.
- 8. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a voltage measurement.
- 9. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a current measurement.
- 10. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter is the phase delay of one of said time-varying mixing signals  $\underline{\phi}_1$  and  $\phi_2$ .
- 11. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter is the fall or rise time of one of said time-varying mixing signals  $\underline{\phi}_1$  and  $\underline{\phi}_2$ .
- 12. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter includes both the phase delay and the fall or rise time of one of said time-varying mixing signals  $\phi_1$  and  $\phi_2$ .
- 13. The radio frequency (RF) down-convertor of claim 2 wherein said synthesizer further comprises:
- a synthesizer for generating time-varying mixing signals  $\phi_1$  and  $\phi_2$ , where said time-varying mixing signals  $\phi_1$  and  $\phi_2$  can change with time in order to reduce errors.
- 14. The radio frequency (RF) down-convertor of claim 1, further comprising: a filter for removing unwanted signal components from said x(t)  $\phi_1$  signal.
- 15. The radio frequency (RF) down-convertor of claim  $2\underline{1}$ , wherein said time-varying mixing signals  $\underline{\varphi}_1$  and  $\underline{\varphi}_2$  are random.
- 16. The radio frequency (RF) down-convertor of claim 1, wherein said time-varying mixing signals  $\underline{\varphi}_1$  and  $\underline{\varphi}_2$  are pseudo-random.

- 17. The radio frequency (RF) down-convertor of claim 1, wherein said timevarying mixing signals  $\varphi_1$  and  $\varphi_2$  are irregular.
- 18. The radio frequency (RF) down-convertor of claim 1, wherein said timevarying mixing signals  $\varphi_1$  and  $\varphi_2$  are digital waveforms.
- 19. The radio frequency (RF) down-convertor of claim 1, wherein said timevarying mixing signals  $\varphi_1$  and  $\varphi_2$  are square waveforms.
- 20. The radio frequency (RF) down-convertor of claim 1, further comprising: a local oscillator coupled to said synthesizer for providing a signal having a frequency that is an integral multiple of the desired mixing frequency.
- 21. A method of demodulating a radio frequency (RF) signal x(t) with reduced local oscillator leakage comprising the steps of:
- generating time varying mixing signals  $\varphi_1$  and  $\varphi_2$  which vary irregularly over time, where  $\varphi_1$  and  $*\varphi_2$  has significant power at the frequency of a local oscillator signal being emulated, and neither  $\varphi_1$  nor  $\varphi_2$  has significant power at the frequency of said local oscillator signal being emulated;
- mixing said input signal x(t) with said time-varying mixing signal  $\varphi_1$  to generate an output signal x(t)  $\varphi_1$ ; and
- mixing said signal x(t)  $\varphi_1$  with said time-varying mixing signal  $\varphi_2$  to generate an output signal x(t)  $\varphi_1$   $\varphi_2$ .
- 22. An integrated circuit comprising the radio frequency (RF) down-convertor of any one of claims 1-20 claim 1.
- 23. A computer readable memory medium, storing computer software code in a hardware

  development language for fabrication of an integrated circuit comprising the radio

  frequency (RF) down-convertor of any one of claims 1.
- 24. A computer data signal embodied in a carrier wave, said computer data signal computer software code in a hardware development language for



- 25. The radio frequency (RF) down-converter of claim 1, wherein said synthesizer uses a single time base to generate both mixing signals  $\varphi_1$  and  $\varphi_2$
- The radio frequency (RF) down-converter of claim 1, where said synthesizer uses different patterns to generate signals  $\varphi_1$  and  $\varphi_2$ .